THE ZOOLOGIST

No. 858.—December 15th, 1912.

A CONTRIBUTION TOWARDS A SOLUTION OF THE PROBLEM OF MIGRATION.

By F. J. Stubbs.

In the following paper an attempt has been made to group together a number of well-ascertained facts with a view to the solution of the ancient problem of migration; but the present essay is merely a preliminary one, for the subject is too vast to be treated adequately here and now. Although the question is very simple, the necessity of explaining a number of separate details gives it a superficial aspect of complexity; yet I think the majority of readers will be able to see the drift of my reasoning before they have covered many paragraphs.

Thanks to the pertinacious labours of an army of workers we are to-day in possession of a mass of accurate observations more than sufficient for the present purpose. The result, to my mind, becomes more than a theory, and this array of facts appears to be governed by a law which, provisionally, may be given briefly as follows:—*The present balance of life on the earth is made possible by the existence of a mobile mass of animal life flowing twice yearly from hemisphere to hemisphere;* and I hope to show that migration, instead of being merely a question for ornithologists, is really a tremendous cosmical function of the utmost importance.

The present discussion confines itself to facts that are the commonplaces of science. There is no necessity to turn for support to matter that is not accepted without question by *all*

naturalists. Indeed, some apology must be made for the inclusion of fragments of the merest elements of science; but I think the best plan is to pass rapidly over this side of the subject, and not run even the very slight risk attached to the step of leaving it altogether to the intelligence of the reader.

Immaterial exceptions, such as plant-eating fungi, animals possessing chlorophyll, &c., have been carefully considered, and will not be referred to again. I do not know of any biological fact that serves as an obstacle in the way of the acceptance of the theory.

Animals live entirely upon plants. There is no exception to this great law, but often it happens that the dependence is indirect, as when a man feeds on the flesh of an herbivorous animal. Sometimes the nourishment passes through a long series of animal forms, but in every case it can be demonstrated that every atom of it comes from the plant, and never from inorganic matters, with the exception of water.

Plants are not to so great an extent dependent upon animals. Their food is inorganic, and most of it is derived from the air. It is a popular error to hold that a plant invariably takes its food mainly from the soil. Very little beyond water is drawn through the roots, and the bulk of the plant is built up from the air breathed in through the leaves. The constituent used is the carbon dioxide (CO_2) present in the atmosphere in the proportion of about ·04 per cent. This is extracted from the air, and the plant returns to the atmosphere the oxygen which is a waste product of growing vegetation. The animal, of course, breathes *in* oxygen and breathes *out* carbon dioxide, and in this way each lives on the waste product of the other. Although carbon dioxide may be evolved by volcanoes, or by certain saprophytic plants, or in other ways, the green plant is practically dependent upon animals for the bulk of its nourishment.

Animals, therefore, can only live in direct association with plants. The latter organisms are not, however, bound down to the neighbourhood of animals, for the carbon is carried to them by atmospheric currents; but soil (except in the case of aquatic plants), water, and sunlight are also necessary for the growth of plants. The last is extremely important, and a knowledge of this fact is the very heart and foundation of a knowledge of

migration. Plants can use the carbon dioxide in the air only in the presence of sunlight. Perhaps it would be better to state now that all energy comes from the sun; in the presence of carbon dioxide plants can and do fix this energy, and turn it into living protoplasm, and this energy is passed on to the animal, and by it converted into heat and motion. Those who have not followed the progress of biology are apt to look upon the above as a species of unscientific mysticism, but indeed it is the groundwork of biology, and has long since ceased to be matter for speculation.

A remarkable point about the carbon dioxide of the atmosphere is that it remains constant in its proportion to the rest of the air. Roughly speaking, there are four parts by volume to ten thousand parts of air, but this actually varies from ·037 to ·062 per cent.—a variation of about ·04 per cent. For our present purposes we can state that the amount of carbon present in the atmosphere remains invariable, although animals are ceaselessly adding to it, and plants are removing it. This suggests that the ratio between plant life and animal life remains rigidly constant from month to month and year to year. What this ratio may be I cannot say, but from a long study of balanced aquaria I should assume that by weight the vegetation of the earth is at the very least several hundred times greater than the animal life.

The plant needs no power of locomotion, for, rooted in the soil, water, air, and sunlight will flow to it and provide it with food. A little thought shows that, as the food of the animal is many times greater in size, locomotion becomes the first essential to the growing animal. At the least it must move about the mass of its pabulum, and this power of movement has been developed to a high degree. The typical animal may be described as a plant-eating mouth and stomach provided with locomotive powers, and its movements are due to the potential energy from the sun gathered and stored in the tissues of the plant.

Three things are essential for plant life—soil, water, and sunlight. Under certain conditions the first may be dispensed with, but the other two never. When all three conditions are present, plants flourish. Latitude has little to do with the question of vegetation, and the countries within the Arctic Circle are often

covered in summer with a luxuriant growth of plants. Some districts, as the interior of Greenland, are plantless, and, of course, tropical deserts may be equally unvegetated. But the great extent of the *tundren* around the North Pole supports, in summer only, a wealth of greenery.

These Arctic plants die down at the approach of winter, for the clear reason that life would be impossible, owing to the absence of sunlight. We can perhaps, for the sake of simplicity, dismiss the soil and the water as factors of plant growth, and confine ourselves for the moment to the third ever-present factor, *solar energy* or sunlight. The amount of the plant life of any area thus depends upon the amount of sunlight poured upon this area. At the Equator, with a regular day of twelve hours' sunlight, the amount remains constant throughout the year, but in temperate and Polar regions the amount varies with the seasons. In Britain, with eight hours of sunlight in winter and sixteen in summer, the difference in vegetation is very marked. Within the Arctic Circle, with utter darkness for one-half the year and constant daylight for the other half, the conditions are still more different. In winter the water is congealed as ice, and the land is in darkness and buried beneath a cloak of snow. In summer the returning sun releases the water, removes the covering of snow, and pours down on the awakening plants a flood of energy. The necessary carbon dioxide is present, as everywhere, in the atmosphere, and the result is the amassing of huge stores of potential energy.

The plants thus share the carbon of the air with the plants of other lands, but if the balance of life is to be kept constant, they must indirectly return their share to the atmosphere. This, of course, can only take place by the medium of animal life. Perhaps this is sufficiently clear, without being further elaborated, and I would like to discuss now a very delicate corner of the subject. It is obvious that, as all plants share equally in the carbon dioxide of the atmosphere and equally add the animal requirement of oxygen to the atmosphere, the balance of life can only be maintained by all vegetation being accessible to animals. The sun (and I beg leave to use here a handy freedom of terms) moves slowly towards the North Pole from the South Pole, but the plants cannot follow it. The

alternative is to die down at its departure, and arise again at its advent. The animal has *two alternatives*—it can follow the sun, or it can die down with the plant: migration and hybernation, in fact.

If we could look upon the Polar Region as an area of life separated from the rest of the world, as a sort of "garden enclosed" containing its just proportion of plant and animal life, and sharing its oxygen and carbon with all terrestrial life, hybernation would be quite sufficient. Plants and animals alike would die down each year, as is, indeed, the case with all the vegetation, and with the entire invertebrate fauna of the district. Migration would thus be unnecessary. It happens, however, that there is no dividing line between the Tropics and the Polar Regions. Theoretically, assuming that there were no migration, and that the balance of life were maintained by hybernation alone, we should require a perfectly regular grading of animal sleep—within the Tropics none at all, at the Poles six months, and every intervening spot from a single day right up to the full Polar limit. I confess that I cannot quite see exactly *why hybernation* should be the exception, and *migration* the rule. Undoubtedly it has something to do with the essentially locomotive powers of animals, and perhaps, too, with the vicissitudes of such continents as Greenland or the Antarctic Regions. This is more a question for the student of the *evolution* of migration, a subject that is quite beside the present paper.* It should suffice to repeat that the present terrestrial biological status is possible only by the existence of either a *hybernating* mass of animal life, or a *migrant* mass of animal life; and it happens that for some reason the method of migration and not that of hybernation predominates to-day.

Viewed in this light, the phenomenon of bird migration, instead of being the esoteric study of the ornithologist, becomes part of a biological law of the utmost importance and magnitude. When we consider this yearly ebb and flow backwards and forwards across the Equator of millions of tons of highly

* One feels privileged to speculate on the effects of a lessening of the inclination of the earth's axis—this would be followed by the extinction of the *migrants* (or rather *eo-migrants*): the birds of to-day, the fishes or flying reptiles of other ages.

organized flesh and blood, and appreciate the indubitable fact that, if it ceased, the whole equilibrium of life would be immediately upset, we are justified in viewing migration as being, after the fact of life itself, the grandest phenomenon of biology.

The present condition of the Antarctic Regions, and the comparatively small area of land within the southern temperate zone, act in disturbing the balance of the annual flow of birds. The data are not available for any safe conclusions on the marine algæ of the southern oceans, and on the migrations of fish and piscivorous birds; but it seems only reasonable to expect that beyond the Equator fishes play a large part in maintaining the equilibrium of life. Towards the north, bird migration oscillates across a line that is considerably nearer the Pole than the Equator, and a great number of species never reach the Tropical Zone, even in winter.

The fact seems to be well established that those birds which reach the most northerly parts in summer migrate farthest south in winter. As a rule, they are remarkable for an apparatus of flight far beyond the ordinarily observed needs of life; and it is very curious that so little attention has been paid to this matter. A Grey Plover, for example, is so powerful a flier that I cannot imagine one being taken by a bird of prey except by chance; and there are many circumstances, unnecessary to mention here, suggesting that the powerful wings of wading birds are not primarily intended for purposes of defence. Certainly they seem out of all proportion to the feeding requirements of the birds, and we can only look upon them as being essentially the organs of migration, and, in a way, merely *secondary* as organs of flight—a paradoxical statement that is yet worth serious attention. Viewed in this way, such long wings enable the bird to overcome the barrier of *distance* protecting the Arctic animals, and are thus analogous to the beak of the Curlew or the eyes of the Owls as specialized feeding organs.

Most wading birds are great migrants, or, rather, it should be put the other way about in saying that many migrants are wading birds. In a general sense a wader is a bird specialized for an existence in non-arboreal marshes. We know that the land around the North Pole, and many other parts of the higher latitudes of the Palæarctic Region, are, in summer, typical

marshes, and therefore more or less closed to birds adapted to woods, thickets, or dry fields. They are, however, suited to the needs of *waders*, and these are the dominant summer birds. But later in the year, when emigration takes place, the structures that fitted the waders for a life in the Arctic marshes prevent them spending the winter in places other than those bearing at least a superficial resemblance to the summer home. For the rest of the year they become "shore birds"; and we must look upon the generalized and most advanced form of migrant as birds passing the summer near the Pole, and with a winter range that is nothing more than the slender tracery of the littoral zones of the remainder of the entire globe.

With "land" birds matters are rather different, and the generalizations are unavoidably broad. So many migrants are insectivores that we may well take all these as forming a type species. In England, in winter, food is lacking. In Africa, on the contrary, the "wet season" has been accompanied by an increase in insects, and the birds pass south to utilize this food; and, incidentally, prevent undue increase on the part of the plant pests, with the possible destruction of the vegetation. With the return of summer England becomes again a fit manufactory of protoplasm. The trees and plants break into leaf. Insects appear and increase, and threaten the very existence of the plants; and, at the most critical season, a vast tide of birds flows north to devour the insects and so preserve the vegetation.

Here, in winter, the poverty of solar energy means a dearth of foliage, and a consequent lack of food for the insects. These animals come to a standstill during the cold season. In the Tropics the conditions are not quite the same. It must be remembered that water is as essential as sunlight to the growing plant, and a dry desert is thus as barren as an Arctic winter continent. But in many parts of the Tropics the year is divided into two seasons, a wet and a dry. The former corresponds to the northern summer in being a period of exuberant growth. This is the breeding time of many birds and other animals, and we know that beyond the needs of the sedentary organisms, there is a surplus sufficient to support the migrants that have passed south to avoid the northern winter. In those parts of

the Tropics that are not so much under the influence of seasonal rains the year *must be* (as a logical outcome of our knowledge of biology) divided into a period of insect abundance and impoverished plants, and another of freedom from insects and large opportunities of storing potential energy. The first would thus correspond to the Arctic summer and the wet season of the Tropics.

Leaving out of account the conditions obtaining in the sea (and possibly aërial migration is exceeded by the passage of marine animals), and looking upon the soil of the entire globe as being equally fitted to support plants, we shall find that the areas of what may be termed the greatest biogenetic intensity are precisely those best provided with water and with sunlight. Over these areas plants are most abundant, and here we expect to see the greatest bulk of animal life. But these very biological *optima* are constantly changing, owing to the disappearance or shrinking of one or both of the two essentials, light and water: the freezing of water, of course, removes it at once from the service of plants. The vegetation, being primarily a stationary form of life, ceases to collect and fix the solar energy, and comes to rest after storing a sufficient reservoir for the following season in the shape of seeds or in the form of starch.

The animal life has two alternatives, hybernation, or migration to the opposite biogenetic pole; and, as we know, migration is the course usually adopted. The *general* trend of the movement is from north to south, in the path of the summer; but there is no theoretical reason why the course of migration should not take the form of a series of radii in all directions from a circumscribed area rendered biologically non-supporting by the disappearance of water. It is, however, more than doubtful if these local migrations could have any real connection with the vast currents of the typical migrants that sweep to and fro each spring and autumn with all the precision and much of the magnificence of one of the heavenly bodies.

Seebohm noticed that birds migrated in spring to the *lightest* parts of their ranges, and he was thus led to suggest that the longer northern summer day, as contrasted with the twelve hours of the tropical day, gave the migrants more time in which to seek food and rear their young. Other writers have

been attracted by this aspect of migration, but I cannot read that any one of them ever considered the formidable obstacle provided by the Nightjar. A simpler and sounder explanation is that migration is caused by nothing more nor less than a lack of food, but this was, to my mind, hardly a solution. It fails in omitting to take into consideration the question of carbon dioxide, and it omits entirely to show that instead of being a mere question of ornithology, migration is really a far-reaching cosmical function that is intimately connected with every single atom of life, plant or animal, on the face of the globe.

A far more popular explanation of the phenomenon of migration is that the birds were crowded out from the Arctic Regions by the growth of the ice-cap, and that a species of nostalgia carries them back to the old home each spring. The actual observations in support of this theory are, I submit, non-existent. It appears to me that in order to obtain the maximum amount of life on the globe annual migration must always be, and has always been, in operation. An inherent *nostalgia* (acting under the influence of *two* homes) is, of course, as essential in a migrant as the power of flight itself. It would be as logical to say that the bird returns each year to the north because it has wings! Really this "Polar Origin" theory, which has as complement the assumption (quite unsupported by palæontological evidence) that the Arctic Regions are the cradle of the class *Aves*, is too palpably opposed to the present one to need more than the briefest mention now.

Again I would say that this essay is merely a preliminary sketch of a very extensive subject. While being quite alive to the possibility of the existence of a fatal flaw in my reasoning, I can state that I have not detected it up to the present; and I should be intensely interested in any fact, or series of facts, that proves me to be in error. It is almost unnecessary to add that the existence of perfectly sedentary birds or fishes is no obstacle. Theoretically, there need be no migration of land birds in some Tropical islands.

THE PHARYNGEAL TEETH OF FISHES.

By Colonel C. E. Shepherd (Indian Army).

(Continued from p. 209.)

The *Sciænidæ* are provided with strong pharyngeal teeth; those of *Sciæna aquila* have been alluded to in the opening article of this series.* The illustration given in Günther's 'The Study of Fishes' shows the formidable array possessed by *Pogonias chromis*. Others will now be dealt with in more detail.

Sciæna amazonica.†

This fish has eighteen horny gill-rakers on the first cerato-hypobranchial arch, the last seven of which are small to rudimentary; they all carry teeth. The longest one at the angle is about the length of the gill lamina below it. There are seven on the first epibranchial, also toothed, of which two are rudimentary. The second, third, and fourth arches have a number of tubercle gill-rakers, all bearing a cluster of cardiform teeth. The upper pharyngeals consist of an elongated patch of small cardiform teeth at the head of the second epibranchial, and a smaller patch of similar teeth on the arm of the third epibranchial. The heads of the third and fourth epibranchial each carry two bones, the upper one with large cardiform teeth, the lower with similar but slightly smaller teeth; this bone also stands well away at its lower extremity from the lining membrane of the mouth. The lower pharyngeals form a broad V on the floor of the mouth with small cardiform teeth, except that along the margins where the fifth branchial arches meet and at the margin next the œsophagus there is a row of strong cardiform teeth.

Corvina nigra.‡ Fig. I.

In this fish nine horny gill-rakers are found in the first cerato-hypobranchial and seven on the first epibranchial arch.

* 'Zoologist,' 1910, p. 418.

† From British Guiana and South America.

‡ From the Mediterranean.

All these are toothed ; they stand on the outer edge of the arch. Along the inner edge of the first arch and on both sides of the next three arches the gill-rakers are tubercles which are toothed ; the tubercles alternate with each other, but are so placed as to leave clear spaces between them for the outflow of water to the gills. The upper pharyngeal teeth are in three portions on each side ; the upper portion is a long narrow slip consisting of pointed

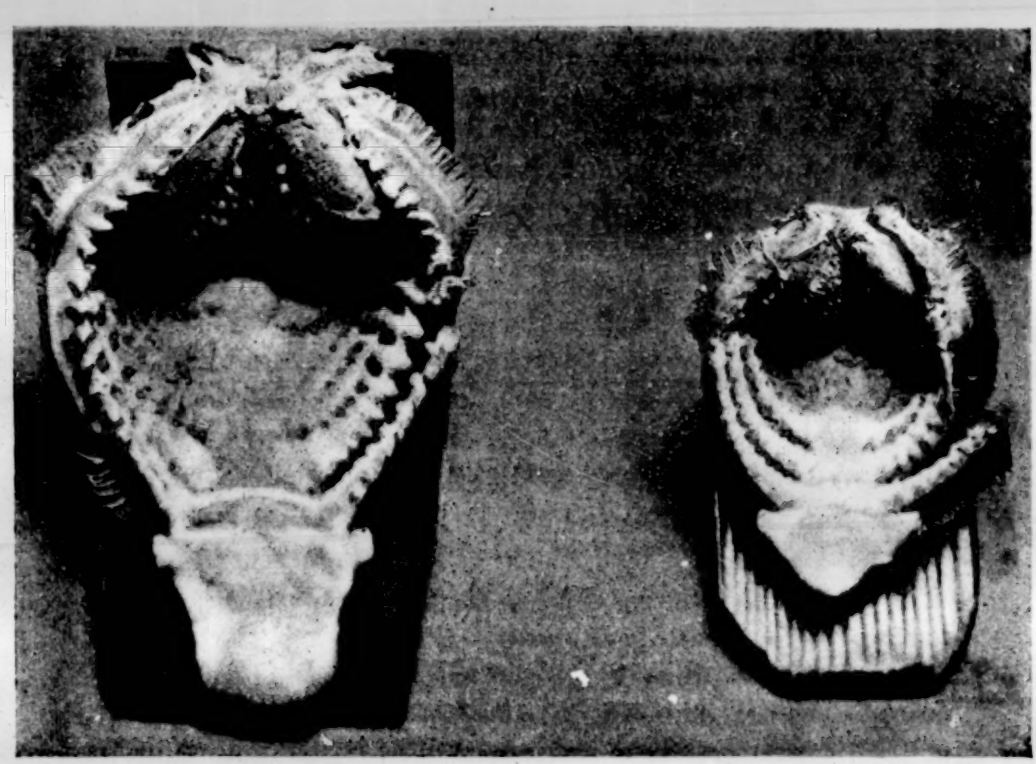


FIG. I.—CORVINA NIGRA. FIG. II.—UMBRINA CIRRHOSA.

teeth along the inner upper edge, with less developed teeth of the same kind interspersed over the rest of the slip. The whole is surrounded with soft mucous membrane. Below the upper slip and on the inner side of it is a patch of granular teeth, not very close together but distinct and strong. Below these again are two patches with pointed teeth showing through, but which are very much embedded in the mucous membrane. The granular upper pharyngeal teeth show clearly in the illustration. The lower pharyngeal teeth are like the granular looking

teeth of the upper. This dentition could cope well with crustaceans and even some molluscs.

Umbrina cirrhosa.* Fig. II.

There are nine gill-rakers from the angle of the first branchial arch forward that bear teeth, and five on the epibranchial, but two of these gill-rakers in each set are rudimentary. The first arch on its inner side, and the second, third, and fourth arches on both sides have tubercle gill-rakers; all of them carry teeth. The tubercles between the first and second arches interlace closely between the others; they have larger openings. The upper extremity of the second epibranchial carries a long narrow set of villiform teeth, quite palpable to the touch; below these and on the inner side of the middle patch are some sharp conical teeth placed round the edges, with some prominent, almost granular, teeth in the centre of the patch. The lowest section of these upper pharyngeal teeth has sharp upstanding teeth. The lower pharyngeal teeth are granular-shaped ones, fairly thickly studded over the surface of the lower pharyngeal bones. The pharyngeal teeth show distinctly in the illustration.

Ancylodon jaculidens.†

Has ten long, horny gill-rakers on the first cerato-hypobranchial; these all bear teeth, with two on the first epibranchial. The gill-raker at the angle is as long as the gill lamina below it. The other arches are but feebly provided with gill-rakers, having only a few tubercles on their upper margins. There is a small patch of upper pharyngeal teeth on the second epibranchial. On the third epibranchial there is a small patch of prominent teeth on the arm of this arch, and at the head of the arm a patch of strong cardiform teeth. At the head of the fourth epibranchial there is a patch of cardiform teeth, but smaller ones than those last mentioned as on the third epibranchial. The lower pharyngeal teeth are likewise cardiform, with a row of extra strong ones along the inner margin of the set.

* From the Mediterranean.

† From British Guiana.

NEBRIS MICROPS.* The Butterfish.

Has fourteen long, horny gill-rakers, which are toothed; on the first cerato-hypobranchial the longest is a trifle longer than the gill lamina below it. There are eight gill-rakers on the first epibranchial. The other arches have short gill-rakers on each side, the whole forming a good filter apparatus. The upper pharyngeal teeth are in three sections of cardiform teeth; a small one on the head of the second epibranchial, one on the head of the third epibranchial of strong cardiform teeth, and one on the head of the fourth epibranchial of smaller cardiform teeth. The lower pharyngeals are in two long portions of cardiform teeth, with very strong ones along the inner margins.

TRIGLIDÆ.

TRIGLA GURNARDUS. The Gurnard.

Has nine upstanding, horny, thick gill-rakers that terminate in a knob studded with teeth. The longest is about the same length as the gill lamina below it; there are also two flat tubercles with teeth. All these are on the first cerato-hypobranchial. On its epibranchial there are two upstanding gill-rakers, knob terminated, and two flat tubercle gill-rakers. The inside of the first arch and both sides of the other arches have very prominent tubercle gill-rakers that fit in from alternate positions on opposite sides, making a close filter; they bear villiform teeth. The upper pharyngeal teeth are set on an elongated plate on the second epibranchial, a broad shield on the third epibranchial, and a smaller patch on the fourth epibranchial; these are thickly studded with minute cardiform teeth. The lower pharyngeal teeth are on two rhomboidal plates of comparatively large size covered with villiform teeth. This fish feeds on molluscs, crustaceans, and small fishes.

TRIGLA LYRA. The Piper. Fig. III., *a*.

Has seven horny, upstanding gill-rakers along the first cerato-hypobranchial, with minute teeth on the inside; they then subside into tubercles, which are also toothed. The inner side of the first, both sides of the second and third, and the

* From British Guiana.

outer side of the fourth arches all carry short fat tubercles, which have a rough surface. The upper pharyngeal teeth, which are villiform, show as a roughly circular patch in the lowest portion, with two concentrical patches in the upper portion. The two plates bearing the lower pharyngeal teeth, also villiform, are so much rounded at the anterior end that they can hardly be called of a triangular shape. The tubercles of the branchial arches, whilst fitting alternately, yet have a small oblong opening for the passage of water to the gills; this shows clearly in the illustration. The food of this fish consists of crustaceans, molluscs, echinoderms, and seaworms.

FIG. III.—*a*. TRIGLA LYRA. *b*. PERISTEDION CATAPHRACTUM. *c*. DACTYLOPTERUS VOLITANS.

PERISTEDION CATAPHRACTUM. The Armed Gurnard (Couch). Fig. III., *b*.

Has twenty horny, upstanding gill-rakers from the angle of the first branchial arch to the end of the hypobranchial, the third one being the longest. There are five on the epibranchial. The other arches carry long narrow tubercles, which fit into each other alternately, so that when the branchial arches are closed together a very perfect filter is formed. The upper pharyngeal teeth, which are villiform, show as a roughly circular patch on each side, with a narrow circular patch above. The lower pharyngeal teeth, also villiform, show as two elongated

triangles, with the narrow apex at the forward end and the base, which is nearly right angled, at the œsophagus end.

DACTYLOPTERIDÆ.

DACTYLOPTERUS VOLITANS. The Flying Gurnard. Fig. III., *c*.

Has eight flat tubercles for gill-rakers along the cerato-hypobranchial of the first arch, with two on the epibranchial. These are all smooth to the touch. The other arches are furnished, as is the inner side of the first arch, with alternating tubercles, which yet leave a small opening between them for the passage of water. The upper pharyngeal teeth are in two rows of distinctly conical teeth in the upper patch, and also similar teeth at the lower portion of a circular pad of teeth; between these sets of conical teeth are villiform teeth. The lower pharyngeal teeth are villiform.

SCOMBRIDÆ.

SCOMBER SCOMBRUS. The Mackerel.

This fish has twenty-eight very long, horny gill-rakers on the first cerato-hypobranchial arch; the longest one is at the angle of the arch, and is about one and a half times the depth of the gill lamina below it. The gill-rakers diminish in size as they approach the tongue, but keep fairly long all the way. There are thirteen on the first epibranchial. All these gill-rakers, although smooth to the touch, have a fringe of small hair-like bristles along the inner face, making each one look like a miniature spoke-cleaning brush. When looked at collectively with a magnifying-glass the whole gives the appearance of a closely-set hair-brush. The gill-rakers on the other arches are short, but covered with the hair-like bristles, the whole forming such a filtering apparatus as to entangle the smallest organisms. The upper pharyngeal teeth are on a thin elongated strip on the second epibranchial, and a long and fairly broad patch on the third and fourth epibranchials; both these are thickly furnished with setiform teeth. The lower pharyngeal teeth are set on two long narrow plates, and are setiform.

SARDA MEDITERRANEA. The Pelamid (Couch). Fig. IV.

The specimen examined had eleven long, horny gill-rakers on the left side of the gullet, and twelve on the right side on the first branchial arch. These gill-rakers had villiform teeth

FIG. IV.—SARDA MEDITERRANEA.

on their inner faces. On the inner side of this arch are fourteen small processes like gill-rakers, also set with teeth. Along the top of the second, third, and fourth arches villiform teeth run all along, but arranged on tubercles which touch each other; on the inner side of these arches there are similar tubercles with villiform teeth, but they are spaced more distinctly apart. The

upper pharyngeal teeth show as a roughened surface of villiform teeth at the upper extremity of the second epibranchial. The third epibranchial carries a long triangular patch of cardiform teeth. The fourth epibranchial has a narrow oblong patch with a rounded base covered with cardiform teeth; the lower extremity of this does not fit close to the lining membrane of the mouth, but can stand out from it. The lower pharyngeal teeth are set in two long narrow plates. There are also in the buccal cavity two oval patches of villiform teeth where the first hypobranchial joins the base of the tongue, and two long patches of similar teeth where the second hypobranchial joins the basi-branchial bones.

XIPHIIDÆ.

Xiphias gladius. The Swordfish. Fig. V.

The illustration shows the gullet of a young specimen from the Mediterranean. There are no gill-rakers of any kind; the branchial arches are smooth. The upper pharyngeal teeth consist of a long narrow patch of villiform teeth on the upper part of the second epibranchial arch. The upper part of the third epibranchial has a long patch, broader at one end than at the other, of villiform teeth, with a smaller patch on the same epibranchial, but lower down. From the top of the fourth epibranchial, and hanging much below the end of the bone and standing with its lower end away from the surface of the mucous membrane of the gullet, is a long patch of villiform teeth. The illustration shows this fairly clearly. The lower pharyngeal teeth are in two long patches, which narrow slightly at their middle portion. This fish is occasionally caught off the coast of the British Isles.

ZEIDÆ.

Zeus faber. The John Dory.

On the first cerato-hypobranchial arch this fish has ten short, broad, horny gill-rakers, mostly upstanding, covered at their tops with minute cardiform teeth; on the summit of the third gill-raker from the angle between twenty and thirty could be counted. The gill-raker at the angle is the largest; it is a trifle over one-half the depth of the gill lamina immediately below it. There is a very evident extra space between this gill-raker and

the one next to it; after that they are fairly evenly spaced, the spaces, however, decreasing as the size of the gill-rakers dwindle towards the end of the hypobranchial, the last two or three becoming small flat plates. The second and third branchial arches have tubercle gill-rakers on each side, those on the inner side being smaller than those on the outer; they are all covered with teeth. The inner side of the first and outer edge of the fourth arch also have toothed tubercles. The top of the second epibranchial has a small patch of cardiform teeth as part of the

Fig. V.—Xiphias gladius.

upper pharyngeal teeth system, and below this on the third and fourth epibranchials is a large protruding patch with strong teeth on it, forming the bulk of the upper pharyngeal teeth. There is one of these patches at each side, and the distance between the upper and lower patches is rather more than is usually found in other fishes. The lower pharyngeal teeth do not lie flat on the floor of the mouth, as in most fishes, but are tilted up, forming an angle roughly of about 120°, with the floor just opposite the swallow. This inclination of the lower pharyngeal teeth gives, with the upper teeth, a very powerful

disintegrating effect when at work—a kind of downward rasping action. The specimen examined had its gill-slits covered with a matted mass of foodstuff that had evidently been subjected to a triturating process, in which the pharyngeal teeth had probably borne their part.

CYTTUS AUSTRALIS. The Silver Dory (Stead).

This fish has fourteen horny gill-rakers of the first ceratohypobranchial arch, with three tubercles at the end nearest the tongue; the longest ones, the third to the ninth from the angle, are about one-half the depth of the gill lamina below them. These gill-rakers are spatulate at the top, and carry a number of small teeth, which also grow upon the three end tubercles. On the first epibranchial there are six small gill-rakers, also tooth-bearing. The other arches have short stumpy gill-rakers, each of which is toothed. At the extremity of the second arch is found a large prominent tubercle covered with teeth. A similar tubercle is found at the extremity of the third arch, but smaller. The upper pharyngeal teeth are in two sections each side, but fitting so close as to look like one prominent patch. The teeth on them are cardiform. The lower pharyngeal stand up high on the floor of the mouth, and consist of two solid patches of minute cardiform teeth.

(To be continued.)

NOTES AND QUERIES.

AVES.

Supposed Occurrence of Scarlet Grosbeak (Pyrrhula erythrina) in Oxfordshire.—On Jan. 31st, 1912, during a spell of hard weather, with north and east winds prevailing, Miss J. H. Blunt, of Adderbury Manor (and, from another window, three adult members of her household), watched, as it was feeding among some birds for whom food had been put out in a courtyard, a bird unknown at the time, but identified by a reference to Howard Saunders's 'Manual' as a Scarlet Grosbeak (*Pyrrhula erythrina*). A coloured sketch of the bird was prepared from memory of its appearance directly afterwards, and most kindly sent to me, and I do not think that anyone who saw this would have any doubt as to the correctness of the identification. The peculiar cap of burnished carmine is characteristic, and well represented in the sketch, and I think the bird must have been a quite adult male. Miss Blunt writes: "It looked like a jewel (ruby) in the sun, on the head and breast . . . a sort of rose-crimson —so different from the red on most other birds." It was not seen again after that day. I will only add that Mr. Harvie-Brown (who, of course, knows this bird well in life), to whom Miss Blunt wrote describing the bird seen at Adderbury, thought it was undoubtedly a Scarlet Grosbeak. This is a welcome addition to our Oxfordshire list of rare birds.—O. V. Aplin (Bloxham, Oxon).

The Perching Habits of Starlings.—For the main purpose of my paper in 'The Zoologist' (*ante*, p. 281), I made no distinction between sheep and cattle. Perhaps deer might be included also, for I have noticed Starlings on these animals; but I find now that I have no notes, nor any safe recollection, relating to horses. To the Jackdaw mentioned by Mr. Morris, I would add the Wagtails, which often perch on cattle. It has occurred to me that a map showing the distribution of the habit in our islands would be rather interesting, and might hold some surprises. For example, the information already available suggests that the whole of Cheshire, and perhaps the whole of Ireland, must be viewed as "non-perching" areas. I should be glad to receive notes relating to any locality, and if I get a sufficient

number I shall try to reproduce this material in the form of a map.—FREDK. J. STUBBS (77, High Street, London, E.).

Starlings on Sheep's Back.—In my note (*ante*, p. 393) there is the following misprint which is worth correcting, as it conveys a wrong impression: "They walked with *care* on the wool." For *care* read *ease*.—F. B. KIRKMAN (Letchworth).

Starlings and Jackdaws on Sheeps' Backs.—It is a common sight in Northumberland, and on the Borders, to see both of these birds perching upon the backs of Sheep, and less frequently on cattle, and the fact has been repeatedly remarked upon in print during the last thirty years. Occasionally, no doubt, the attraction may be parasites, but quite often it is only a conveniently raised resting place for observation, and shepherds would be glad if the birds could be induced to abandon the practice, for during hot weather the resultant droppings on the fleece attract flies, which often means sore backs—fly-blown spots—needing immediate attention, and which a careful man is constantly on the look-out for amongst his flocks.—GEORGE BOLAM.

Spoonbills (Platalea leucorodia) in Suffolk.—Possibly a few words with reference to the three Spoonbills referred to by Mr. Patterson (*ante*, p. 420) which I was fortunate enough to see in Suffolk may be of interest. It was in the evening of June 4th that I saw them; I was at the end of Easton Broad nearest the sea, when three very large white birds rose at the opposite end, and for a moment I could not think what they were. However, when I got my field-glass on them, there could be no doubt at all, and though they never came within two hundred yards, I had an excellent view. They circled about, and at last I lost sight of them. A Heron came into the range of the glasses at the same time, and the difference in flight was very conspicuous: the Heron with neck drawn back, and with a rather heavy, laboured flight, and the Spoonbills with their necks fully extended, and a flight which appeared to be as graceful and easy as a Gull's. I looked for them again, but never saw them; however, some boys who were bathing in the Broad told me they had seen them, and described them as "tall birds," one of them suggesting that they were Storks. To see a new bird for the first time is always a pleasure, and a sketch I made of one of the Spoonbills, which a friend has been good enough to reproduce as a lantern-slide for me, will be an interesting memento of the incident.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds).

Migrations of Bernacle-Geese. — From several accounts which have come to hand it is evident that there has been a movement of Bernacle Geese (*Bernicla leucopsis*) on the east coast this autumn.

In Surrey.—In the 'Shooting Times' of Oct. 12th, Mr. E. J. Heiden Cronan wrote that a gaggle of eight had been frequenting a flooded meadow near Dorking since Oct. 2nd. He approached within thirty yards of them on the 4th, but beyond paddling away from the edge of the water they showed no signs of alarm. Boisterous weather had been experienced there a few days previously.

In Northumberland.—On Oct. 15th my friend Mr. John Black wrote me from Scremerston, near Berwick-on-Tweed, that the station-master there had shot two Bernacles from a flock of eight on Oct. 14th. I received the head and wing of an immature bird. They were wonderfully tame, feeding in a stubble near the line. They had departed two days later. On Oct. 21st a notice appeared in the 'Newcastle Daily Journal' to the effect that on Oct. 17th a flock of about thirty "wild geese" flew over Canada Farm, Longframlington, near Morpeth. Five of the birds settled just in front of the farm-stead, and remained there for about half an hour, allowing the farm-workers to approach within a very short distance of them. I immediately wrote to Mr. James Robson, The Manse, Longframlington, who had inserted the notice, and obtained the reply that the birds were Bernacle Geese. They had arrived from the south-east, and appeared to be making for the "Black Lough," which lies about three miles north-west of the farm. The following day (18th) about a dozen passed over in the same direction at 4 p.m. The five which had settled near the farm the previous day were so tame that Mrs. Renwick and the farm-workers got round them and drove them like domestic fowls close to the house before they took flight.

In Scotland.—In the 'Shooting Times,' Nov. 16th, a correspondent writes from the Forth that a fine mature Bernacle was handed to him for identification about Nov. 8th.

The Bernacle is a comparatively rare bird on the east coast, and especially so in Northumberland, so that these records, occurring as they did within a radius of about a month, points to the fact that a considerable movement was probably taking place. It would be interesting to know if others have heard of any Bernacles on the eastern seaboard this autumn. — JOHN M. CHARLTON (Cullercoats, Northumberland).

Partridge breeding in October.—About the middle of October, 1909, a friend of mine was walking through some swedes on his farm

at South Newington, near here, when a single Partridge rose in front of him, and he shot it. On going to pick up the bird he found that it had risen from a nest of eight eggs placed at the side of a swede. That laying was still going on was afterwards proved by finding a fully developed egg in the bird when it was dressed for the table. The summer of that year was very wet and cold (and October, too, was a wet month), and probably the later broods and nests all perished, though the early ones got off, and it is possible that these October eggs were laid by a bird which lost her nest in June, and did not make another attempt to rear a brood during the summer.—O. V. Aplin (Bloxham, Oxon).

Little Terns on Ayrshire Coast.—In August last, on the Ayrshire coast, seven miles south of Girvan, I saw four Little Terns (*Sterna minuta*), two parent birds and two young, the old birds feeding the young as they sat on the sand. They rose as I approached, and I shot one of the young, which I have had prepared as a museum specimen. As far as I can gather from local authorities, the bird has never been seen on this coast before.—Melvin H. Rattray (Bootham School, York).

The Fulmar.—Mr. Harvie-Brown, in his interesting paper on this bird, quotes (p. 408) from my first Spitzbergen paper in 'The Zoologist' for 1882 (though under a designation almost amounting to an alias), but has perhaps overlooked the notes on my second expedition, published in 'The Zoologist' for 1883–4. In that paper (1883, p. 485) he will find nearly half a page additional devoted to this question of grey plumage. When writing the article on this species for the fourth edition of 'Yarrell,' Mr. Howard Saunders wrote to me concerning the dark form, which he considered as something rare, but I could only tell him that out of the thousands I had seen not one seemed to tally with the description of the light phase. Apparently he could not credit the statement, judging by what he published there, and subsequently in his 'Manual.' He did not give his authority for the statement in both works that round Spitzbergen both forms are numerous.—Alfred H. Cocks (Poynetts, Skirmett, near Henley-on-Thames).

Technical Terms for Assemblies of Birds. — Referring to the notes on this subject (*ante*, p. 440), may I suggest a few terms for some of the commoner species:—A mock of Starlings, perched; a glint of Starlings, feeding; a wave of Starlings, flying; a school of Jackdaws; a nibble of Bullfinches, feeding; a squad of Rooks;

a tease of Sparrows; a band of Swifts; a glitter of Goldfinches; a cluster of Crows; a creep of Larks, feeding; a party of Tits; a glean of Pheasants.—Stanley Lewis (Wells, Somerset).

Some Notes on the Carrion-Crow: Correction.—Under the above heading (*ante*, p. 426), instead of reading: "She does not leave the nest in the same way as a Magpie does or a Ring-Plover," read: She does not leave the nest in the same way as a Magpie does or a Ring-Dove.—Stanley Lewis (Wells, Somerset).

OBITUARY.

Ramsay Heatley Traquair, M.D., LL.D., F.R.S., V.-P.R.S.E., F.G.S., &c.

In the 'Geological Magazine' of June, 1909, an excellent account (with a striking photograph) of Dr. Traquair appeared, and at considerable length. Moreover, a shorter notice in the 'Scotsman' on Nov. 23rd, 1912, the day after his death, by a distinguished geologist, dealt also with his palæozoological labours; whilst a third appreciative notice by Dr. Smith Woodward in 'Nature,' Nov. 28th, still further covers this aspect of his career; so that these will be curtly alluded to now. Born on July 30th, 1840, at the Manse of Rhynd, Perthshire, where his father was minister of the parish, his early education, after his father's retirement, took place in Edinburgh. Even in his school days he preferred quiet walks in the neighbouring country—where he collected butterflies and moths, as well as hammered the shales at Wordie—to the athletic games of his compeers, for his naturally slight physique rendered him then and subsequently less fitted for such exercises. The study of medicine then was considered an admirable training in biological science, just as it is now, notwithstanding the narrow views of the late Scottish University Commissioners, and Traquair entered the University of Edinburgh in May, 1857, when its fame as a Medical School was at its zenith. Of quiet and studious habits, and imbued with a love of nature, he yet at once found kindred spirits in the old dissecting-room of Goodsir, and formed friendships lasting for more than half a century with those who appreciated the genius and kindliness lurking under the reserved exterior. As a student he did not enter the class-competitions, and

thus was not conspicuous in the prize-lists, but he conscientiously worked up every subject, and at the same time made substantial progress with his studies in zoology—so much so as to attract the attention of men like John Goodsir, William Turner, John Cleland, and James Young Simpson. The recesses between the sessions he often spent with his sisters at St. Andrews, where his natural bent found full scope either amongst the shells of the beach, the ironstone nodules of the east rocks, or in other kindred pursuits—such as exploring the fauna of Tents Moor, or in hauling a Porpoise out of the harbour for study and subsequent maceration. He spent five years at the University, graduating in 1862, and at the same time receiving a gold medal for his thesis on the Asymmetry of the *Pleuronectidæ*, a subject which his remarkable skill in dissection, his patience and his accuracy and taste in drawing, fitted him in every way to excel. Goodsir appreciated the talent of his young student and made him his Prosector, and then Demonstrator from 1863 to 1866, when he received the appointment of Professor of Natural History in the Royal Agricultural College, Cirencester, and the gift of a silver dissecting-case from his Edinburgh students; but as the main duty was to teach botany to somewhat lively agricultural students, the study of the oolitic geology of the neighbourhood was a congenial recreation. In 1867 he was chosen as the first Professor of Zoology in the Royal College of Science, Dublin, and in the autumn of 1873 he secured the appointment of Keeper of the Natural History Collections in the Royal Scottish Museum, Edinburgh, a post in which his special talents, and more especially his unrivalled capacity for dealing with the anatomical structure of fossil fishes, found free play. Yet he was not unmindful of the purely zoological side of the Museum, and under his management, with the able assistance of Mr. Eagle Clarke, great strides were made with mammals, birds, and fishes, as well as with the Invertebrates. His kindly aid also was of great service in exchanging with other Museums, and both Perth and St. Andrews have good reason to remember his valued services in this respect. His official and other visits to the Continent gave him unique opportunities for extending his knowledge of fossil fishes, and, besides visiting Museums, he travelled much in Belgium and Germany, hammer in hand, entranced in forest and mountain scenery. Besides, he held the Swiney Lectureship in Geology at the British Museum for two periods of five years, and acted as external Examiner in Zoology in the University of Edinburgh. Many of his memoirs were communicated to the Royal Society of Edinbugh, in which he

took a deep interest, and was one of its Vice-Presidents. As a scientific worker he was not rapid, but careful and exact, and his conclusions were ever held in esteem, whilst his fine drawings and those of Mrs. Traquair were worthy of all praise. It is true he may have yearned for a Scotch Professorship, yet it is doubtful if in that capacity he would have had either the time or the opportunity for the splendid work he accomplished in the Palæichthyology, especially of the Devonian and Carboniferous Strata, of Scotland. In the Royal Scottish Museum he laboured for thirty-three years, producing no fewer than one hundred and thirty memoirs and papers, chiefly on fossil fishes, his researches being based on morphological structure, and not on the scales and teeth so much relied on by Agassiz and the older workers. After a year or two of failing health, he passed quietly away on the 22nd of November.

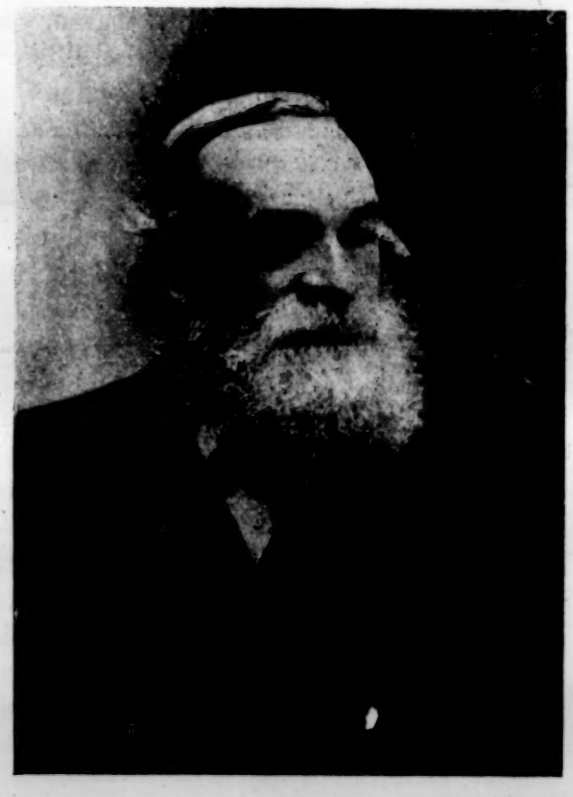
Dr. Traquair was elected a Fellow of the Royal Society of London in 1881, received the Degree of LL.D. of Edinburgh in 1893, was awarded the Neill Medal (1878) and the Macdougall-Brisbane Medal (1901) of the Royal Society of Edinburgh, the Lyell Medal of the Geological Society of London (1901), and a Royal Medal of the Royal Society of London in 1907. A true worker, he laboured until he fell, and our country is the poorer by the absence of one of the most distinguished authorities in Palæichthyology, of a genial, cultured, and kindly man of science, and of a lover of everything that was noble and good.

W. C. McIntosh.

William Forsell Kirby.

W. F. Kirby, who passed away on Nov. 20th, in his residence at Chiswick, was born in Leicester on Jan. 14th, 1844, and was therefore in his sixty-ninth year. He was the eldest son of Samuel Kirby, a banker, his mother's maiden name being Lydia Forsell, and it was her proposition that young William should make a collection of butterflies, thus probably starting a well-known entomological career. This had already been incited by the constant reading of 'Uncle Philip's Conversations with Children,' while an old friend of the family (Dr. Noble) had given him a copy of Duncan's 'British Butterflies.' His mother disapproved of schools, so he and his brothers were privately educated, a fact which he regretted, as he thought that the companionship of other boys might have firmed a too gentle disposition,

and in after life enabled him to combat or ignore many critical shafts which deeply wounded a most sensitive nature. His first tutor was Richard Waddington, a man of considerable literary attainments, who had translated Bodenstedt's 'Thousand and One Days in the East' from the German. Here the pupil probably imbibed his future love of the literature appertaining to the 'Arabian Nights.' From 1857 to 1860 he resided at Brighton, where his education was continued under Frederick William Stevens, and about this time he published



his first entomological writings in the 'Entomologist's Weekly Intelligencer.' In 1860 he left Brighton and came to London, and during 1864–65 studied Chemistry under Dr. L. W. Wood. In 1862 he published 'A Manual of European Butterflies.' In 1866 he married a young lady of considerable attainments (Johanna Maria Kappel), who was during her lifetime a great assistance to him in his literary and scientific work. The greater part of 1866 was passed in Germany, where he collected insects and plants, and studied German, Italian, and Persian. About this time he received an appointment in the

Museum of the Royal Dublin Society, afterwards the Museum of Science and Arts, his colleagues being Dr. Carte and Alexander Goodman More, and it was then the writer of this notice first made his acquaintance, while in 1871 he published his 'Synonymic Catalogue of Diurnal Lepidoptera,' a work which formed an epoch in the study of Rhopalocera. In 1879 he was transferred to the British Museum. He joined the Entomological Society of London so long ago as 1861, and acted as Secretary to that Society from 1881–85. He was known among entomologists as a bibliophile. He knew the literature of his subject as a whole better than any contemporary colleague, and his work principally lives in the different synonymic catalogues he has compiled on Lepidoptera, Odonata, Orthoptera, &c., for which his literary erudition particularly qualified him.

But Entomology failed to confine his literary versatility. He contributed some bibliographical and other notes to Burton's great edition of the 'Thousand and One Nights,' and his collection of European editions of this charming work is said to be probably the best in the world. He also translated the 'Kalevala' from the original Finnish, and this, in two volumes, was published in 1907. On the Councils of the Folklore, Goethe, and Anglo-Russian Literary Societies he had served, and last year was President of the Viking Club. He was a mystic, deeply interested in Occultism and Theosophy, and possessed a very fair knowledge of the old Hindu philosophy and early Egyptian doctrines. He from time to time contributed to the pages of 'The Zoologist,' and in 1908 we published a paper from his pen "On the Longevity of British Entomologists."

Mr. Kirby was of a retiring disposition, and required knowing, but when that was accomplished a sterling character was discovered. Like all of us, he had his limitations and compensations, and his sensitive nature was easily disturbed. His congenial work was in a museum or library, probably in the latter.

W. L. D.

William Bernhard Tegetmeier.

We regret to record that this well-known naturalist, full of years —for he was in his ninety-seventh year—passed away at Golder's Green on Nov. 19th.

Mr. Tegetmeier was born at Colnbrook, Bucks, in 1813, and was the eldest son of a surgeon in the Royal Navy, who was a native of Hanover. George III. was then on the throne, and Mr. Tegetmeier

thus lived under the reigns of six sovereigns. In the days of his boyhood he kept wild birds, and afterwards was a well-known authority on Pigeons, and it was largely owing to this knowledge that through Yarrell he made the acquaintance of Darwin, who was then pursuing his epoch-making researches in the variation of plants and animals. Tegetmeier's name frequently appears in the writings of the great evolutionist. He was on the staff of the 'Field' for about fifty years, for over forty years wrote leading articles for the 'Queen,' and contributed the article on Poultry to the ninth edition of the 'Encyclopædia Britannica.' His separately published works are well known as relating to Pheasants, Poultry, and the House-Sparrow.

Other landmarks in his long life were his being the oldest holder of a reading ticket at the British Museum; he secured that privilege in 1833, at the age of seventeen. He was an original member of the Savage Club, and its first Joint Secretary with Andrew Halliday.

NOTICES OF NEW BOOKS.

The Mechanistic Conception of Life: Biological Essays. By Jacques Loeb, M.D., Ph.D., &c. Chicago: University of Chicago Press. London: The Cambridge University Press, Fetter Lane.

This volume consists of the reprint of a number of essays and addresses on a subject which has recently been much discussed in this country, and, to use words in the introductory essay, the question is: "whether our present knowledge gives us any hope that ultimately life, *i. e.* the sum of all life phenomena, can be unequivocally explained in physico-chemical terms." The verdict, however, so far as these essays are concerned, may be given as "non proven."

The problem is a complicated one, and of necessity enters the field of ethics, which we read "must be influenced to a large extent through the answer to this question." If, however, as Dr. Loeb says, it may be argued, "if our existence is based on the play of blind forces and only a matter of chance—if we ourselves are only chemical mechanisms—how can there be any ethics for us?" He answers his own inquiry by the opinion "that our instincts are the root of our ethics, and that the instincts are just as hereditary as the form of our body." We would here desiderate a definition of both the terms "instincts" and "ethics," as understood in this discussion. However, we are now travelling beyond the purview of 'The Zoologist.'*

We can, however, follow Dr. Loeb more easily in some of his biological conclusions. Such a paragraph as the following is

* Dr. Loeb, at p. 70, writes:—"It is evident that there is no sharp line of demarkation between reflexes and instincts. We find that authors prefer to speak of reflexes in cases where the reaction of single parts or organs of an animal to external stimuli is concerned; while they speak of instincts where the reaction of the animal as a whole is involved (as is the case in tropisms)." But does this explain the statement on p. 31:—"We struggle for justice and truth since we are *instinctively* compelled to see our fellow beings happy"? The italics are our own.

worthy of all consideration by evolutionists:—"Under the influence of the theory of natural selection the view has been accepted by many zoologists and psychologists that everything which an animal does is for its best interest. The exact doctrine of heredity, founded by Mendel and advanced to the position of a systematic science in 1900, reduces this idea to its proper value. It is only true that species possessing tropisms which would make reproduction and preservation of the species impossible must die out."

The Home-life of the Terns or Sea Swallows. Photographed and described by W. Bickerton, F.Z.S., M.B.O.U. Witherby & Co.

In this publication Mr. Bickerton has described, with a number of beautiful illustrations, the home-life of the five species of Terns which visit the British Isles every summer for their nesting season, and his work again accentuates that modern aspect of ornithological study based on patient and careful watching of the living birds with the use of the camera. In this way a new literature is accumulating which describes the domestic economy of birds, while photographs of the living creatures in the most interesting episodes of their existence supplement the knowledge derived from the drawers of skins or mounted specimens in cases. This practice also assists in the preservation of many of our rarest species; the gun is replaced by the camera, and in these islands at least the time is approaching when the special collector of killed birds will be regarded somewhat in the light of an ornithological vandal. We are not, of course, alluding to the necessary collection of skins in other areas, nor even to an unconditional rule in Britain, but the collector with the gun should be controlled, not only by legislation, but, what is more, by public opinion. We, however, write under a full conviction of our own personal sin in the matter. At p. 33 of this volume statistics show what Lord Muncaster has achieved in the preservation of Terns at the Ravenglass Gullery. The wholesale egg-collector is also found deservedly arraigned in these pages.

For those who require an intimate knowledge of the home-life of these birds this little book can be heartily recommended, especially as regards the Roseate Tern, of whose habits so little

is known—so far as this country is concerned—while the locality at which the observations have been made has been properly suppressed. The photographs of this bird and its eggs *in situ* are, as believed by Mr. Bickerton, "the first of this rare and interesting bird that have ever been taken or published in the British Isles."

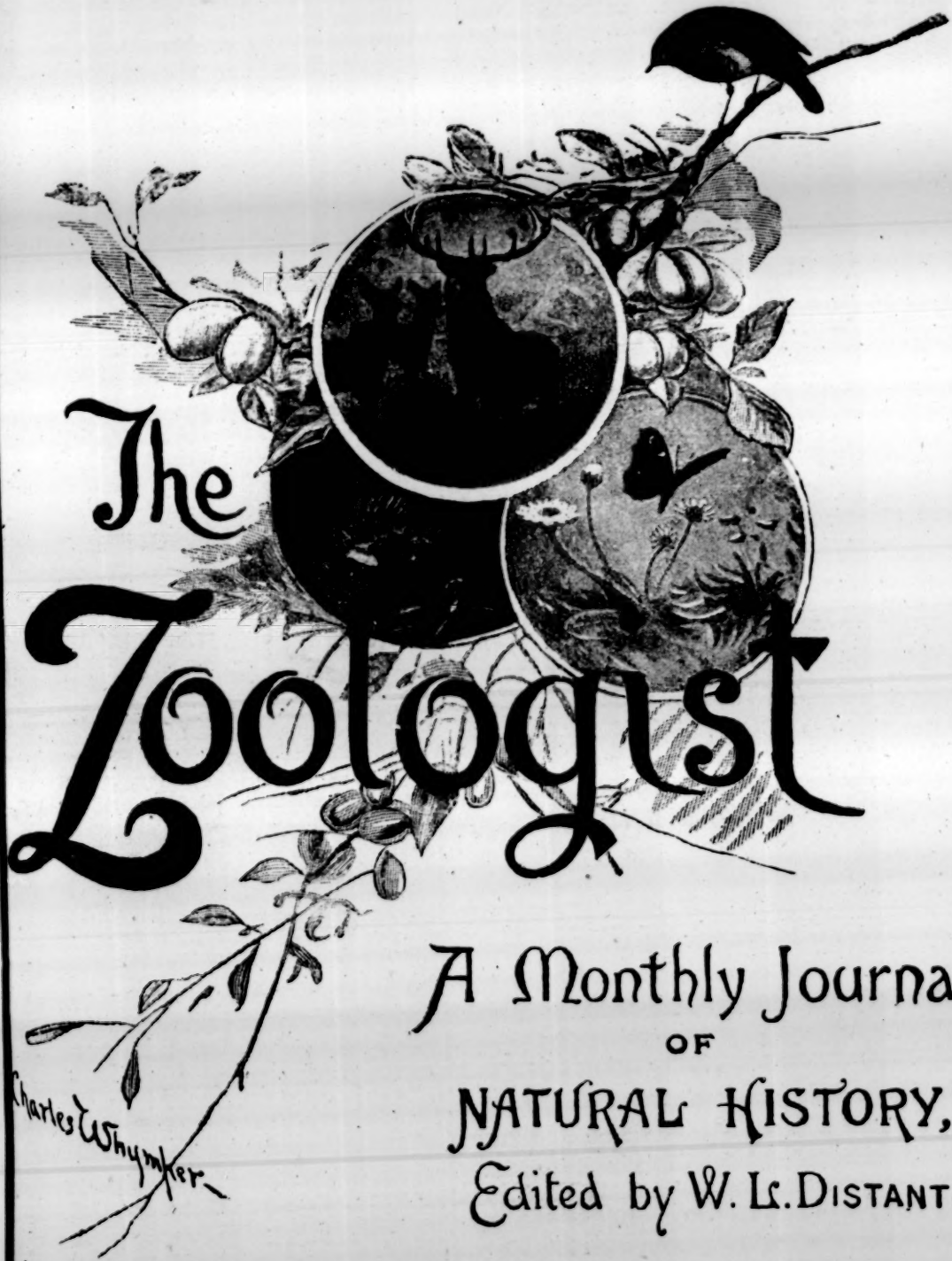
Report on the Immigrations of Summer Residents in the Spring of 1911; also Notes on the Migratory Movements and Records received from Lighthouses and Light-vessels during the Autumn of 1910. By the Committee appointed by the British Ornithologists' Club. Witherby & Co.

This important publication forms vol. xxx. of the Bulletin of the British Ornithologists' Club, and is edited by W. R. Ogilvie-Grant. On the migration of birds it is an astounding collection and compilation of reports and observations made by trustworthy authorities, well arranged, properly condensed, and conveniently published in distinct sections. One sometimes wonders at the face value of many published observations; an answer is supplied by this Report, where each recorded item of avian appearance is, as it were, passed through a great ornithological clearing-house, and appears in its proper registry. It is often said that naturalists are not business men; it would be well if many yearly financial records were prepared with the discretion, method, and fulness of this Report. Mr. Ogilvie-Grant would have made a great accountant; it is a matter of satisfaction, however, that he presides over these annual avian migration reports, and remains an ornithologist.

The thanks of all who study this fascinating subject are also "due to the Master and Elder Brethren of the Trinity House for the continuance of their permission to enlist the services of the light-keepers," and we would add the remark—entomologists, please copy.

PRINTED BY WEST, NEWMAN AND CO., HATTON GARDEN, LONDON, E.C.

Fourth Series.
Vol. XVI.. No.. 181 } January 15th, 1912. No. 847.



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SIMPKIN, MARSHALL & Co Limited.

PRICE ONE SHILLING.

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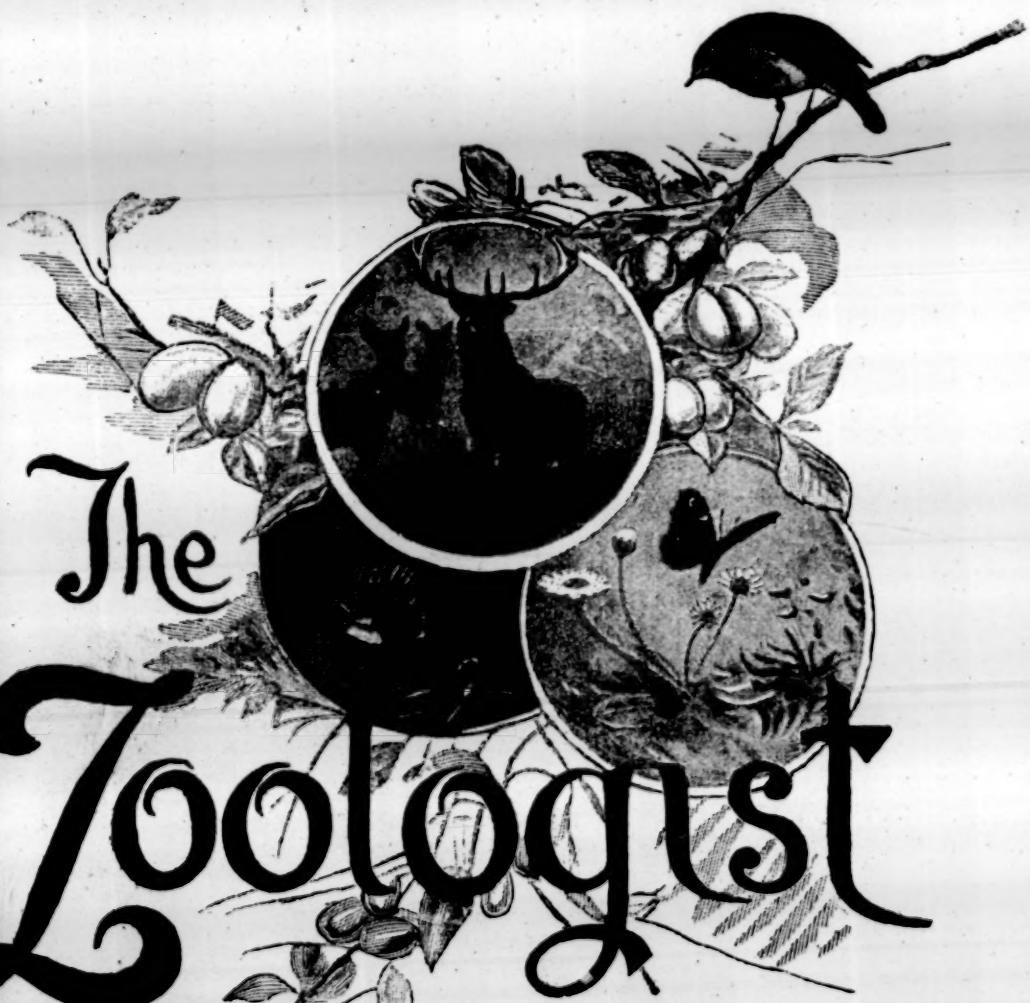
Vol. XVI., No.. 182 | February 15th, 1912. | No. 848.



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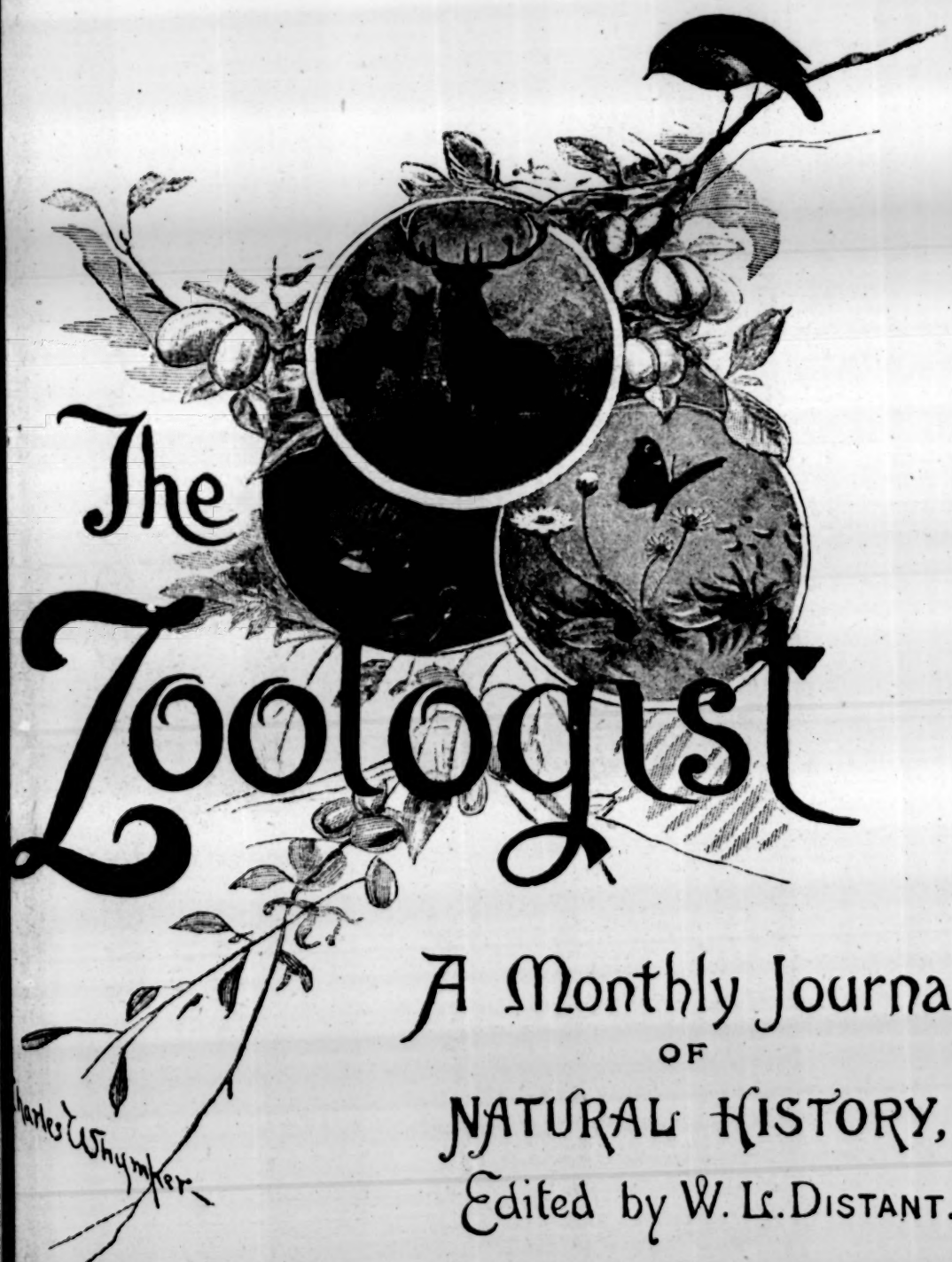
Vol. XVI., No.. 183

March 15th, 1912.

No. 849



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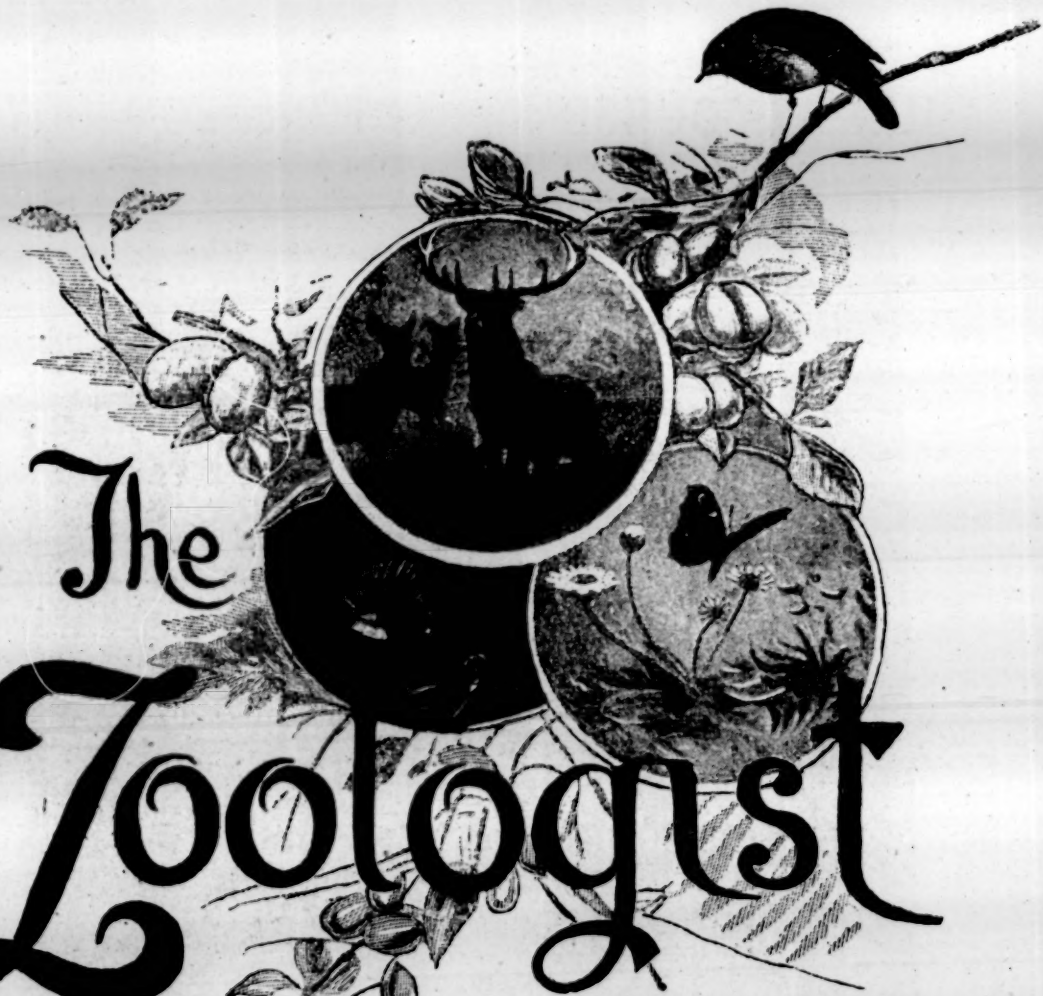
Fourth Series.
Vol. XVI., No.. 184

April 15th, 1912.

No. 850.



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Fourth Series.
Vol. XVI., No.. 185

May 15th, 1912.

No. 851.

The Zoologist

A Monthly Journal OF NATURAL HISTORY,

Edited by W. L. DISTANT.

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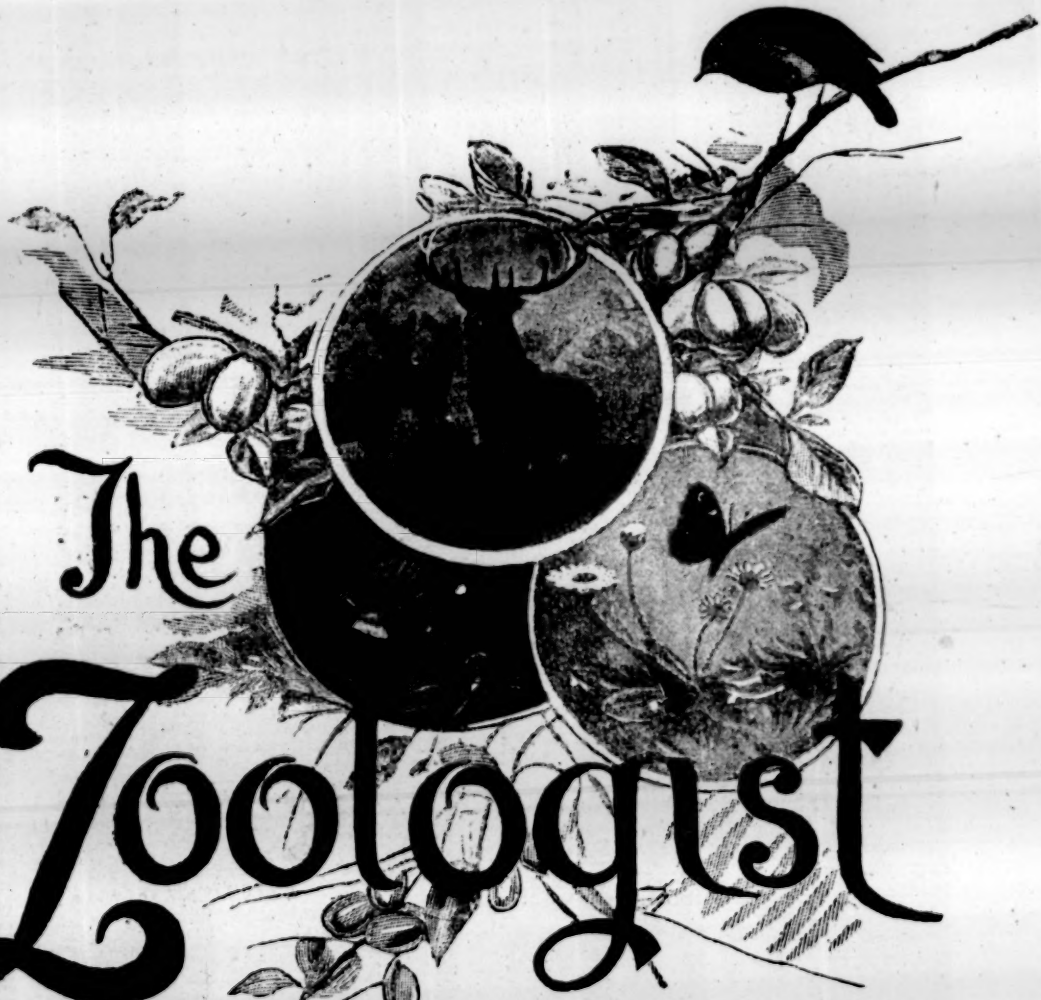
Fourth Series.
Vol. XVI., No.. 186

June 15th, 1912.

No. 852.



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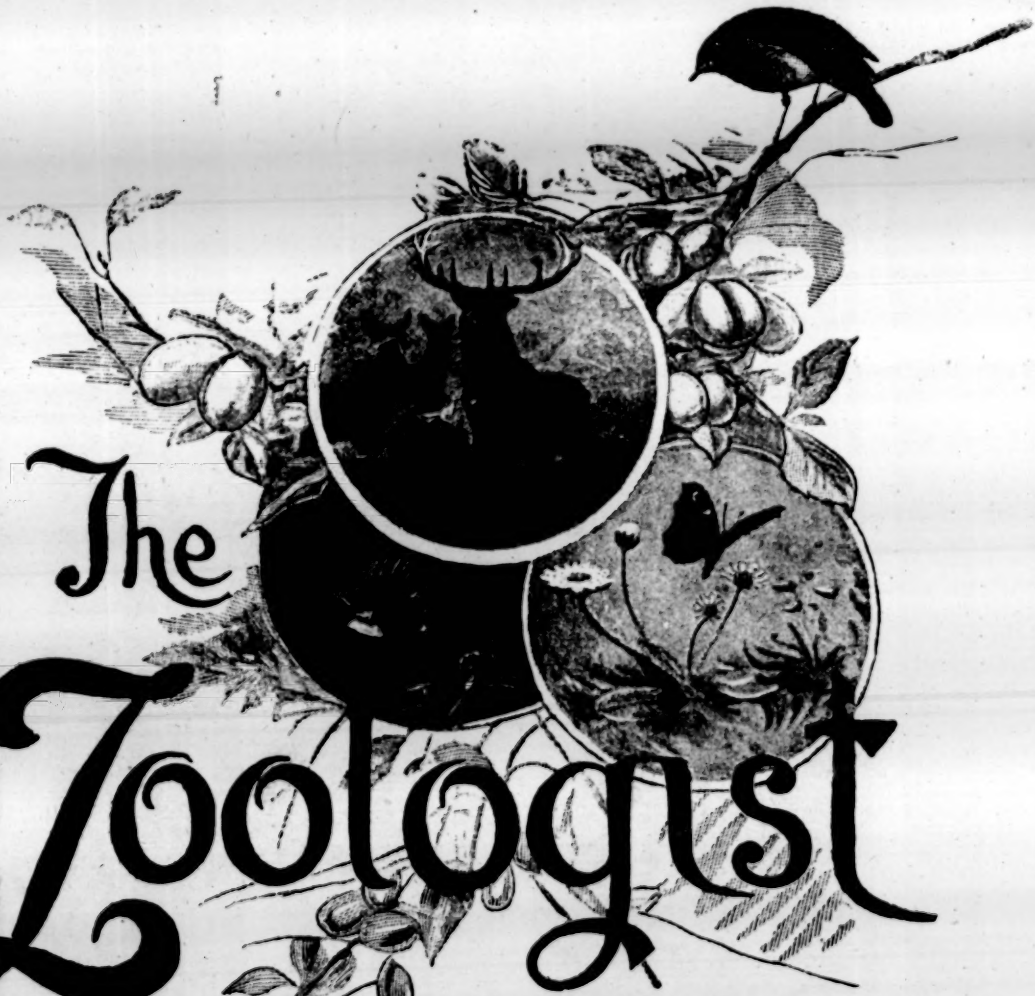
Vol. XVI., No.. 187 July 15th, 1912. No. 853.



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Fourth Series.
Vol. XVI., No.. 188 } August 15th, 1912. No. 854.

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Fourth Series.
Vol. XVI., No.. 189

September 16th, 1912.

No. 855.

The Zoologist

A Monthly Journal OF NATURAL HISTORY,

Edited by W. L. DISTANT.

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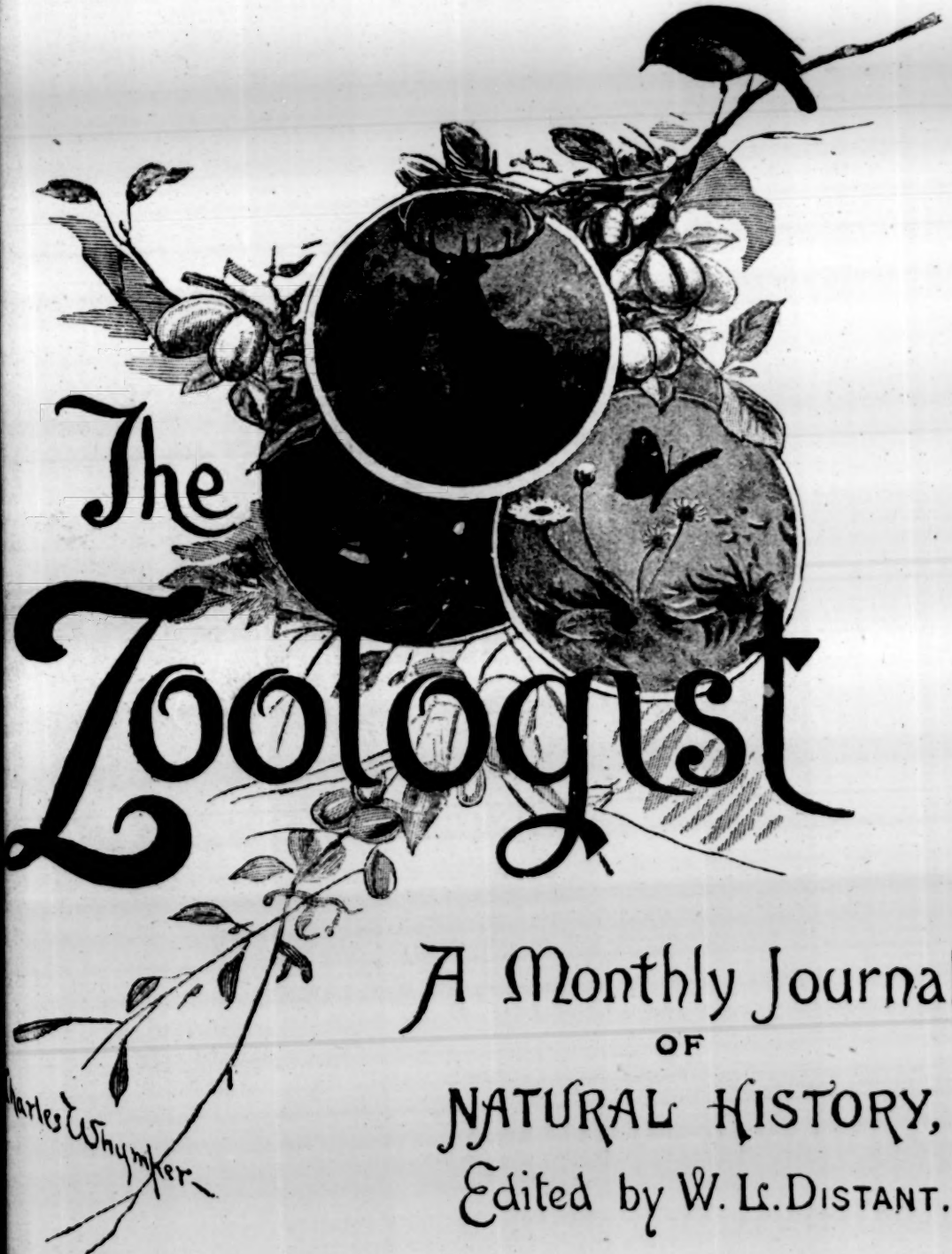

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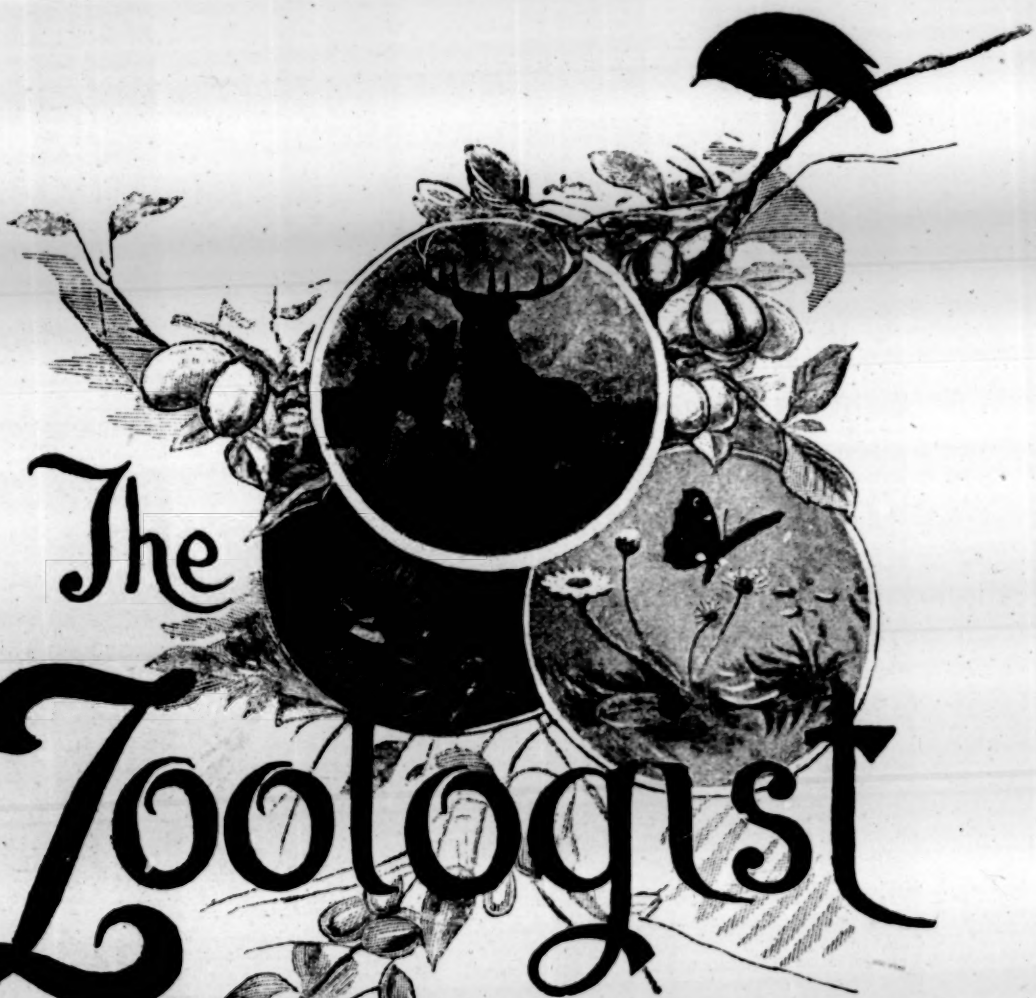

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Fourth Series.
Vol. XVI., No. 192.

December 16th, 1912.

No. 858.

The Zoologist

A Monthly Journal OF NATURAL HISTORY,

Edited by W. L. DISTANT.

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